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Professional Experience

- Thin film X-ray diffraction analysis: I have extensive experience in measurement methods and analysis techniques for general-purpose X-ray diffraction and for specialized thin film work. Specifically, I have used Bragg (q - $2q$) geometry and asymmetric and symmetric mode grazing incidence X-ray scattering (GIXS), rocking curve analysis, and pole figures on sealed tube and rotating anode lab sources and at beamline 7-2 of Stanford Synchrotron Radiation Lab. While working for Profs. Bilello and Yalisove, our group installed an 18kW Rigaku rotating anode source in our lab and commissioned it for use with both a Huber 4-circle goniometer and with an Inel position-sensitive detector collecting scattering in-situ from thin films during growth. I played a major role in commissioning the 4-circle goniometer and have obtained experience in maintenance of the rotating anode and alignment and use of both the 4-circle goniometer and the in-situ geometry. Throughout my work I have emphasized understanding the data I have collected as thoroughly as practically possible with respect to the objectives of the data collection, frequently through the use of simulations for comparison of data to theory. This understanding has led to improvement of my experimental techniques and analysis.
- X-ray reflectivity analysis: I have applied the technique of X-ray reflectivity to determination of the thickness and roughness of thin films by comparison of data to simulations. The utility of this technique lies partly in its speed and minimal equipment requirements: I have used it to calibrate the thickness of a deposition on our laboratory x-ray source while the substrates for the next deposition were in the growth chamber being pumped down to the base pressure for the next deposition. A more thorough analysis involves the material's absorption and critical angle for total external reflection for the wavelength used, information which is also necessary for GIXS studies. I have developed an algorithm for modeling of X-ray reflectivity from multilayers and applied it to trilayers.
- Thin film stress measurement: I have extensive experience in substrate curvature techniques for thin film stress measurement, including Double Crystal Diffraction Topography (DCDT) and laser scanning. In addition, I have determined stress in crystalline thin films from the shift of X-ray diffraction peaks. I have extended this technique to include determination of full three-dimensional strain tensors in amorphous thin films by Fourier transform analysis of GIXS data sets collected along several diffraction vectors.
- Equipment design: In my work on DCDT, GIXS, the rotating anode 4-circle X-ray source in our lab, and X-ray topography (below) I have designed and built many high-precision parts and complete systems, including computer interfaces and control programming. I have programmed in BASIC, FORTRAN, C, and Turbo Pascal. I am capable of using basic machine tools for non critical work, but the complex or high-precision machining I have designed has always been performed by professionals.

- Microscopy: I have experience with the operation of several scanning electron microscopes (Hitachi S-800 and S-520, Philips XL30 and XL30FEG), transmission electron microscopes (Philips EM420, JEOL 2000FX and 4000EX), the Digital Instruments NanoScope III scanning probe microscope, and optical microscopy. I have performed compositional analysis using energy dispersive X-ray analysis in the SEM. The TEM sample preparation techniques I have successfully applied include grinding and ion milling for plan views, chemical etching of Si substrates for plan views, grinding and ion milling for cross sections, and tripod polishing for cross sections. In one study, my tripod polished cross section samples required only 2-30 minutes of ion milling and over 50% of the samples which began the polishing process produced publication quality data. I was a laboratory teaching assistant for a graduate level course in TEM experiment and theory. I have used the technique of Nomarski optical microscopy, which provides a height correlation sensitivity of several nanometers, for inspection of substrates and other critical polished surfaces.
- Thin film deposition: I have experience with the operation of a Denton Vacuum DC magnetron sputter deposition system, although I was not responsible for its maintenance. My growth experiments produced thin films of B4C, which presented special problems due to the tendency of the brittle target to break from thermal stresses.
- X-ray topography: I played a major role in the design and commissioning of a real-time synchrotron Laue topography system for in-situ tensile testing of large single crystals on beamline 2-2 of Stanford Synchrotron Radiation Lab. This experiment involves control of a tensile testing experiment by one computer coordinated with continuous frame grabbing of images of one Laue spot on a second computer and recording of the video signal on a VCR. The project has since become the focus of Mr. Zhibo Zhao, as shown in the Co-authorships section under Publications above.

Publications (Journals)

J. Hershberger, F. Kustas, Z. U. Rek, S. M. Yalisove, J. C. Bilello, "Degree of Crystallinity and Strain in B4C and SiC thin films as a function of processing conditions," Mat. Res. Soc. Symp. vol. 524: Application of Synchrotron Radiation Techniques to Materials Science, Spring 1998, in press.

Z. B. Zhao, J. Hershberger, A. Chiaramonti, Z. U. Rek, J. C. Bilello, "Real Time In-Situ Studies Of Deformation Processes Of Metallic Crystals And Thin Films Via X-ray Topography," Mat. Res. Soc. Symp. vol. 524, Application of Synchrotron Radiation Techniques to Materials Science, Spring 1998, in press.

A. K. Malhotra, J. F. Whitacre, Z. B. Zhao, J. Hershberger, S. M. Yalisove, and J. C. Bilello, "An In-Situ/Ex-Situ X-ray Analysis System for Thin Sputtered Films," submitted for publication to Surface and Coatings Technology.

J. Hershberger, F. Kustas, Z. U. Rek, S. M. Yalisove, J. C. Bilello, "Structure determination of B4C and SiC thin films via synchrotron high-resolution diffraction," Mat. Res. Soc. Symp. Proc. #505: Thin Films-Stresses and Mechanical Properties, Fall 1997, in press.

Z. B. Zhao, J. Hershberger, S. M. Yalisove and J. C. Bilello, "On the Measurement of Residual Stress in Thin Films," Mat. Res. Soc. Symp. Proc. #505: Thin Films-Stresses and Mechanical Properties Fall 1997, in press.

Z. B. Zhao, J. Hershberger, Z. U. Rek and J. C. Bilello, "Real Time Observation of Materials Deformation Processes by Synchrotron X-ray Topography," Mat. Res. Soc. Symp. Proc. #502: In Situ Diagnostics and Materials Processing Fall 1997, in press.

J. Hershberger, T. Ying, F. Kustas, L. Fehrenbacher, S. M. Yalisove, and J. C. Bilello, Surface and Coatings Technology 86-87 (1996) 237.

Z. B. Zhao, L. J. Parfitt, J. Hershberger, S. M. Yalisove and J. C. Bilello, "A Comparative Study of X-ray versus Laser Curvature Method" (Presented at Materials Research Society, Fall 1996 meeting), to be submitted to J. Vac. Sci. Technol.

Publications (Reports)

J. Hershberger, Z. U. Rek, S. M. Yalisove, J. C. Bilello, "Structure of an Amorphous Thin Buried Layer," 1997 Stanford Synchrotron Radiation Laboratory Activity Report, Proposal 2346.

J. Hershberger, Z. U. Rek, S. M. Yalisove, J. C. Bilello, "Strain Tensors in Amorphous Thin Films," 1997 Stanford Synchrotron Radiation Laboratory Activity Report, Proposal 2346.

Z. B. Zhao, J. Hershberger, Z. U. Rek and J. C. Bilello, "Synchrotron X-ray Topographic Studies on Deformation of Single Crystals," Stanford Synchrotron Radiation Laboratory Activity Report, 1997, in press

J. Hershberger, F. Kustas, L. J. Parfitt, Z. U. Rek, S. M. Yalisove, J. C. Bilello, "Structure of Sputter Deposited Boron Carbide and Silicon Carbide Thin Films," 1996 Stanford Synchrotron Radiation Laboratory Activity Report, Proposal 2346Mp.

Z. B. Zhao, J. Hershberger, Z. U. Rek and J. C. Bilello, "An Apparatus for In Situ Real Time X-ray Topographic Observation of Deformation Processes of Materials," Stanford Synchrotron Radiation Laboratory Activity Report, 1996, A266.

Education

PhD, Materials Science & Engineering, University of Michigan
BS, Materials Science and Mechanics, Michigan State University